Space Weather Technical Forecast

Issued on Wednesday 19 February 2025 at 12:06 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with occasional C-class activity, peaking at C4.2 at 19/1049 UTC from AR3997 in centre disc.

There are currently eight sunspot regions on the visible disc. AR3992 has now rotated off the west limb. AR3990 has faded over the last 24 hours and has now lost its opposite polarity spots, reverting to a more straightforward magnetic structure. However, this region does have a connected filament, which extends to its southeast, which has recently become unstable and will continue to be monitored for any potential lift-off. AR3996 in the southeast has shown some minor growth of intermediate spots, but remains fairly simple magnetically. AR3998 has shown some growth within its intermediate area. The remaining regions appear relatively simple at present.

No Earth-directed CMEs have been observed. The filament near AR3990 showed some instability starting around 18/0000 UTC and again following C-class flaring between 19/1000-1200UTC , but no CME is apparent in available imagery at present.

Solar Wind / Geomagnetic Activity: Solar winds as measured by ACE and DSCOVER at L1, were slightly elevated or elevated, varying between 450-520 km/s. Density was mostly slightly above average. Interplanetary Magnetic Field, Bt, was mostly weak until the likely arrival of a CME around 18/1930UTC, becoming moderate at times, peak 11nT. The north-south component, Bz, was mostly weakly positive at first, but then extended periods of negative/southward developed between 18/1930-19/0600UTC, peak -10nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was mainly Quiet at first (Kp 1 to 2), but then increased to Unsettled to G1/Minor Storm (Kp 3-5) between 18/2100-19/0900 UTC, following the aforementioned CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 persisted at background levels. High energy electron flux (greater than 2MeV) at GOES16 was moderate to high, peaking at 1510pfu at 18/2155UTC. The associated 24-hour fluence was below the Active threshold (1e8 integrated pfu), with the 19/0000UTC observation being 8.27e7 integrated pfu.

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Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be generally Low, with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no CMEs currently assessed as Earth directed. However, a glancing CME was observed arriving at around L1 at 18/1930 UTC, with a steady rise in the solar wind speeds, peaking near 520km/s overnight UTC. The CME probably left the Sun during the 14-15 Feb.

Otherwise, the now slightly elevated solar wind speeds are expected to gradually ease towards background as the influence of CH15/- wanes. Geomagnetic activity is expected to be mostly Quiet to Unsettled with a chance of Active intervals at first on Day 1. Any chance of further G1/Minor Storm activity is now slight and reducing.

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background levels, with a slight chance of rising above S1 in response to any larger flares. High energy electron fluence is likely to remain below the Active threshold.

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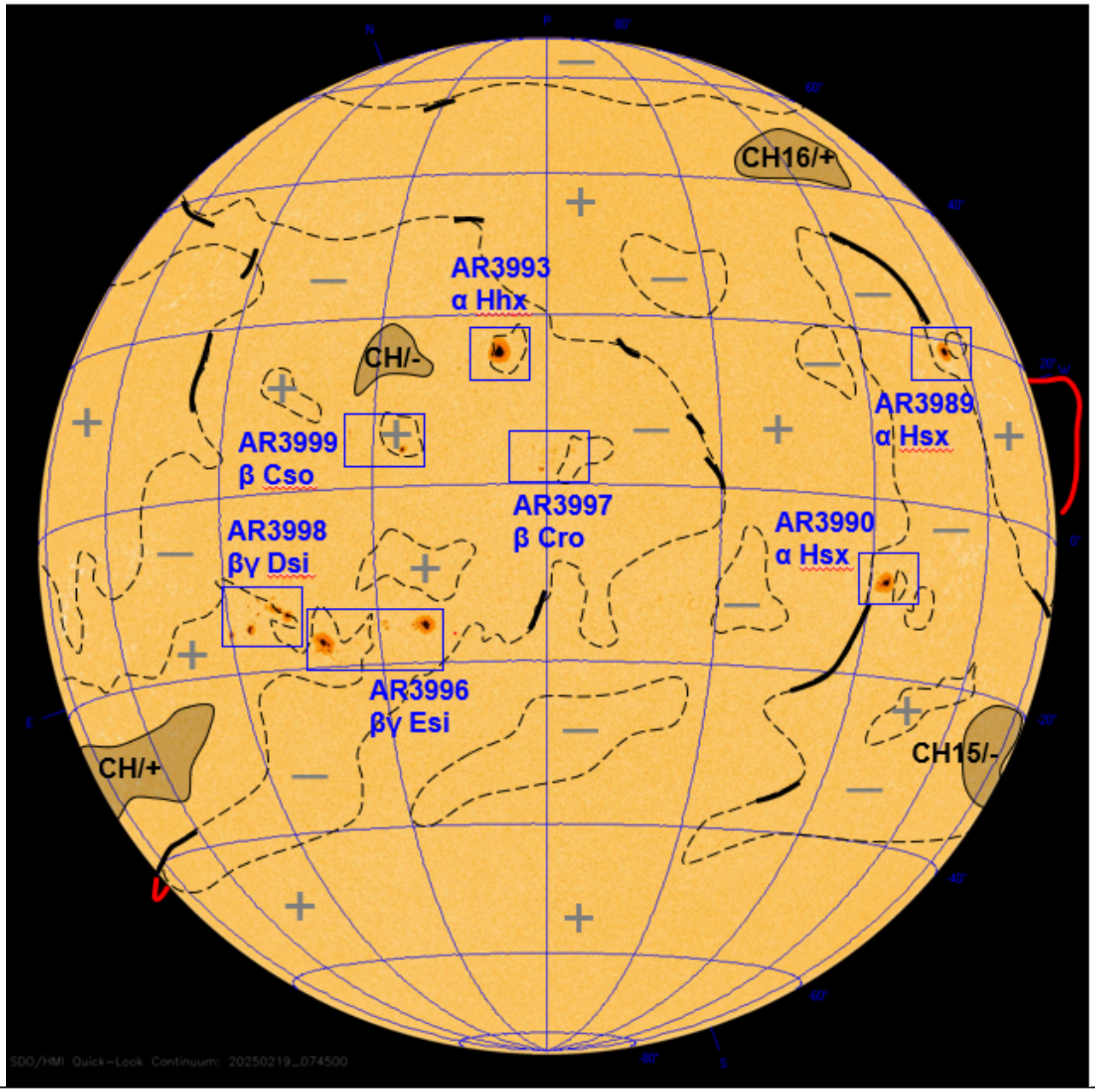
Figure 1: Solar synoptic map, valid at 19/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Several CMEs were observed leaving the Sun on February 14th and 15th, mostly originating from AR3990 or AR3994, and from a filament eruption. Confidence in all of the CMEs is low, with limited coronagraph imagery for analysis and an apparent eastward deflection of the CMEs, likely due to CH15/-.

However, a likely glancing CME arrived at L1 overnight (UTC), with the Bz becoming moderately negative (southward) for a time, with a temporary slight increase in the solar wind speeds, peaking near 520km/s. Geomagnetic activity is expected to be mostly Quiet to Unsettled with a chance of Active intervals at first on Day 1. Any chance of further G1/Minor Storm activity is now slight and reducing.

Otherwise, the ongoing fast wind conditions originating from CH15/-, are expected to continue to gradually ease from elevated towards background levels by the end of the period. This is supported by MOSWOC Enlil.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	10	1	1	1
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2: MOSWOC ENLIL - shows a gradual exit from recent HSS from CH15.

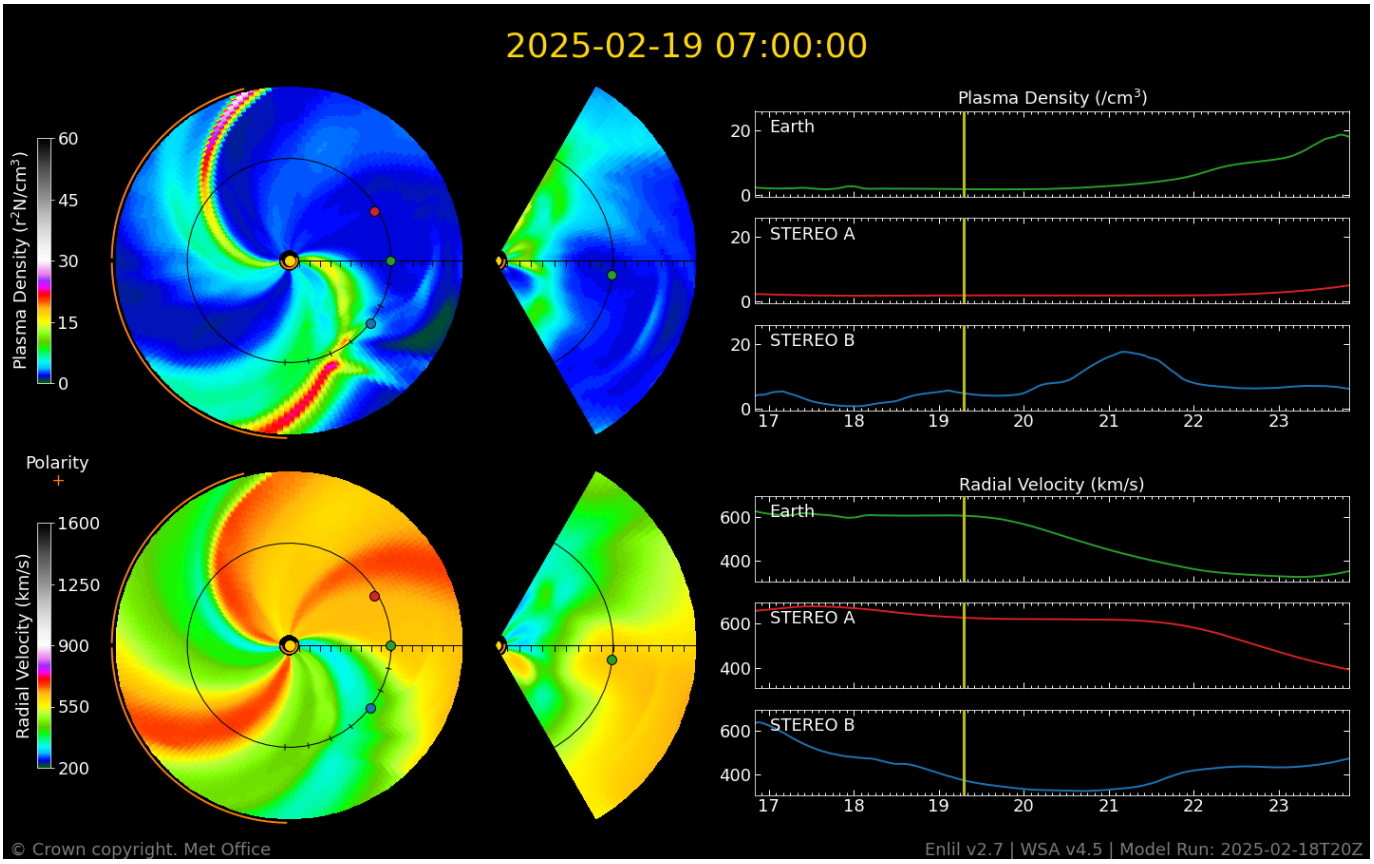
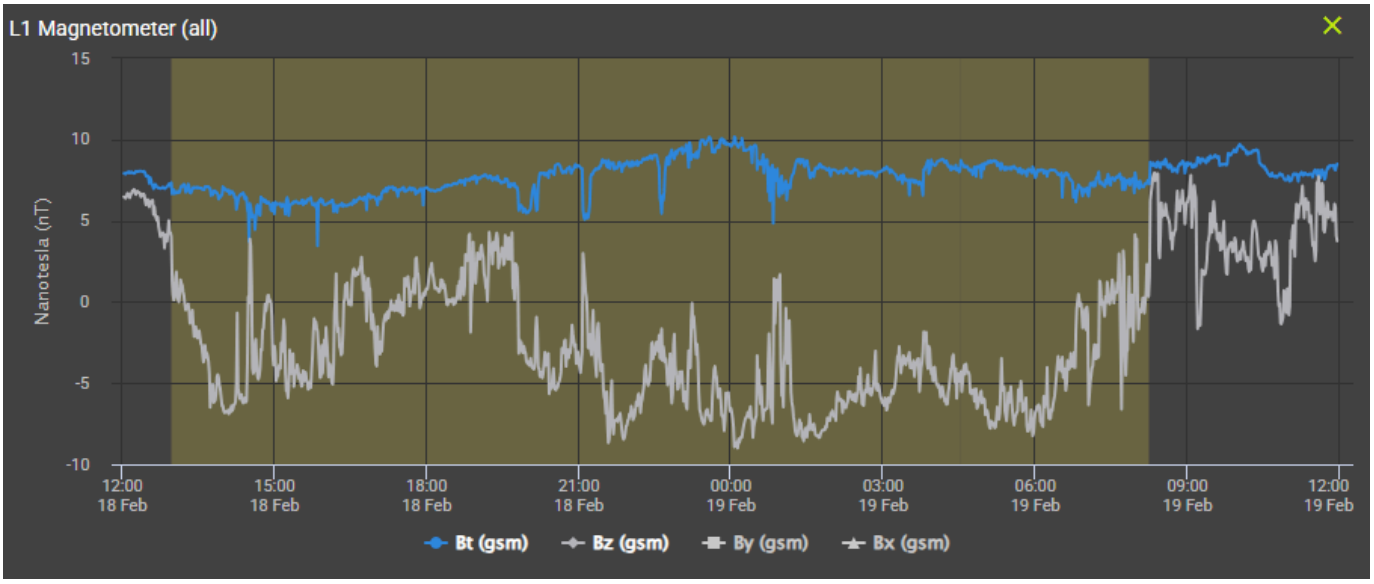


Figure 3: L1 magnetometer shows the likely arrival of a CME around 18/1930 UTC.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low with occasional C-class activity, peaking at C4.2 at 19/1049 UTC from AR3997 in centre disc.

There are currently seven sunspot regions on the visible disc. AR3990 has reverted to a more straightforward magnetic structure, however this region does have a connected filament extending to its southeast which has recently become unstable and will continue to be monitored for any potential lift-off. There are two moderately large bipolar spot groups (AR3996 and AR3998) located in the southeast quadrant showing some magnetic complexity. AR3996 has exhibited some reduction of intermediate spots in recent imagery, but remains a wide group with fairly large lead/trailer spots. AR3998 has shown some waxing/waning within its intermediate spots. Remaining regions are either small or magnetically relatively simple at present, and stable or in slight decay.

Solar activity is forecast to be generally Low, with a chance of isolated M-class flares. These perhaps most likely from AR3990, especially if any disruption occurs with its connected filament, or from the two larger regions in the southeast quadrant of the disc.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	40	40
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux is most likely to persist at background levels, but with a slowly increasing chance of enhancement due to any flaring from AR3990 as this region moves further across the better connected western hemisphere. Along with an increasing risk from AR3996 and AR3998, and other developing regions, as they move towards the centre disc, this brings a slight chance of the observed flux rising above the S1/Minor radiation storm threshold.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux as observed at GOES-16 has been Moderate to High in recent days, due to the charging within the Van Allen Belt that recently occurred from the connection to the fast wind of CH14/15. As solar winds continue to ease, this charged environment is expected to largely persist, although there are signs of a decreasing trend with the current observations running lower than they were 24 hours previously following some CME influence. However, there is just a chance of the easing wind speeds allowing increased flux from lower orbits to expand towards GEO, so a renewed rise is not completely out of the question. However, the recent arrival of a weak glancing CME may suppress the electron flux. Overall, confidence is low.

The associated 24 hour fluence did reach the Active (1e8 integrated pfu) threshold on 17 Feb, but has since dropped below the Active level. Fluence is likely to remain below the Active threshold. Confidence for Active fluence during the period is low, but there is a chance of this occurring. MOSWOC REFM is now also forecasting fluence levels to remain below the Active threshold.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	30	30	20	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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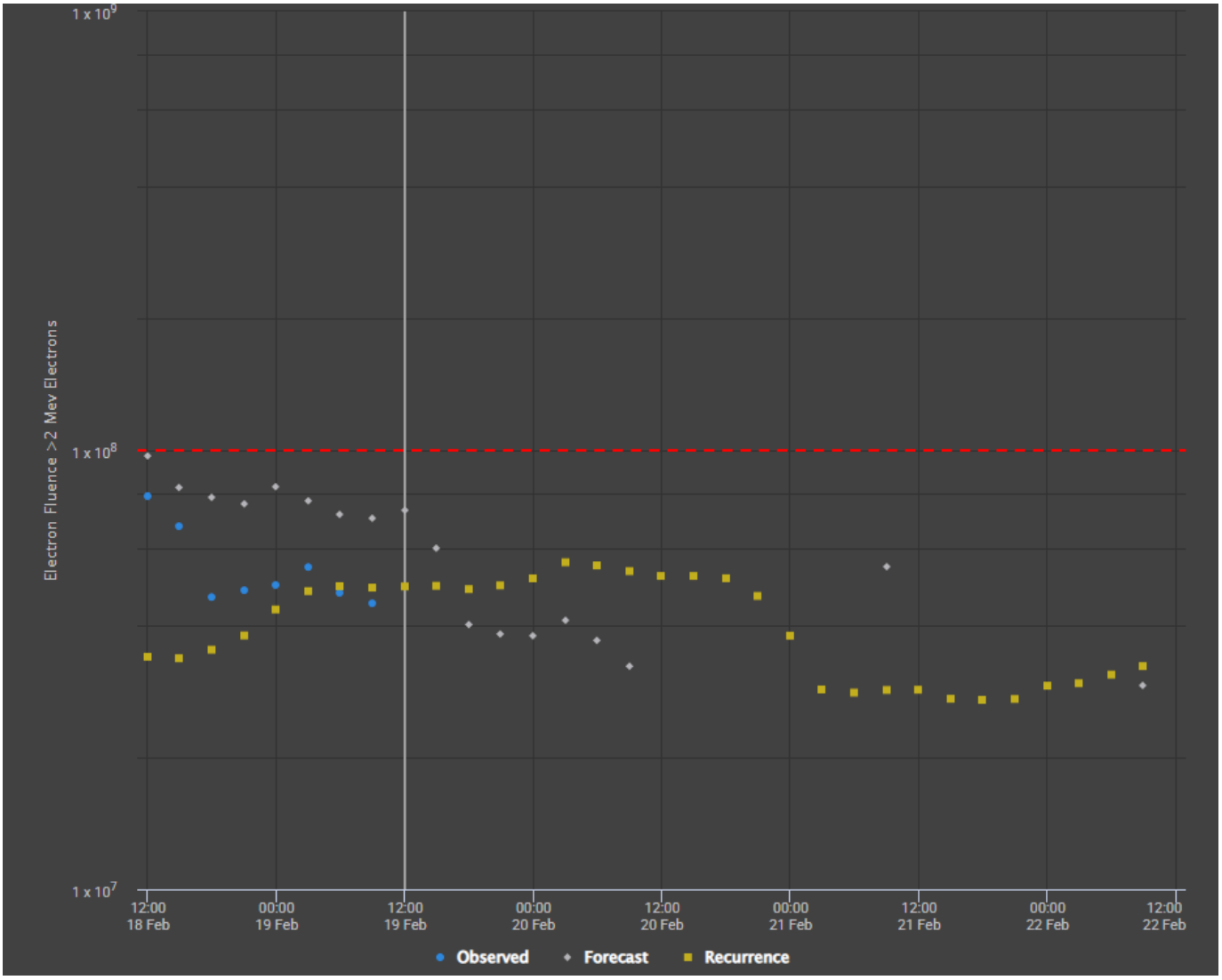
Figure 4: MOSWOC REFM



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